

An aerial photograph of Lake Erie showing a massive green algal bloom in the western basin. The bloom is a large, irregularly shaped area of bright green water, contrasting sharply with the deep blue of the open lake. The shoreline on the left is densely packed with agricultural fields in various shades of green and brown. Several small islands are visible on the right side of the lake. The text is overlaid in the upper right corner.

Microcystis Blooms in Western Lake Erie 2002-2006

Thomas B. Bridgeman

Observations

Microcystis blooms have formed in 4 of the past 5 years

2002 - No bloom

2003 - Large bloom (August)

2004 - Medium bloom (July)

2005 - small bloom (July)

2006 - Medium bloom (August)

Questions

1. What determines the occurrence and size of blooms?

Observations

Blooms form near Maumee Bay



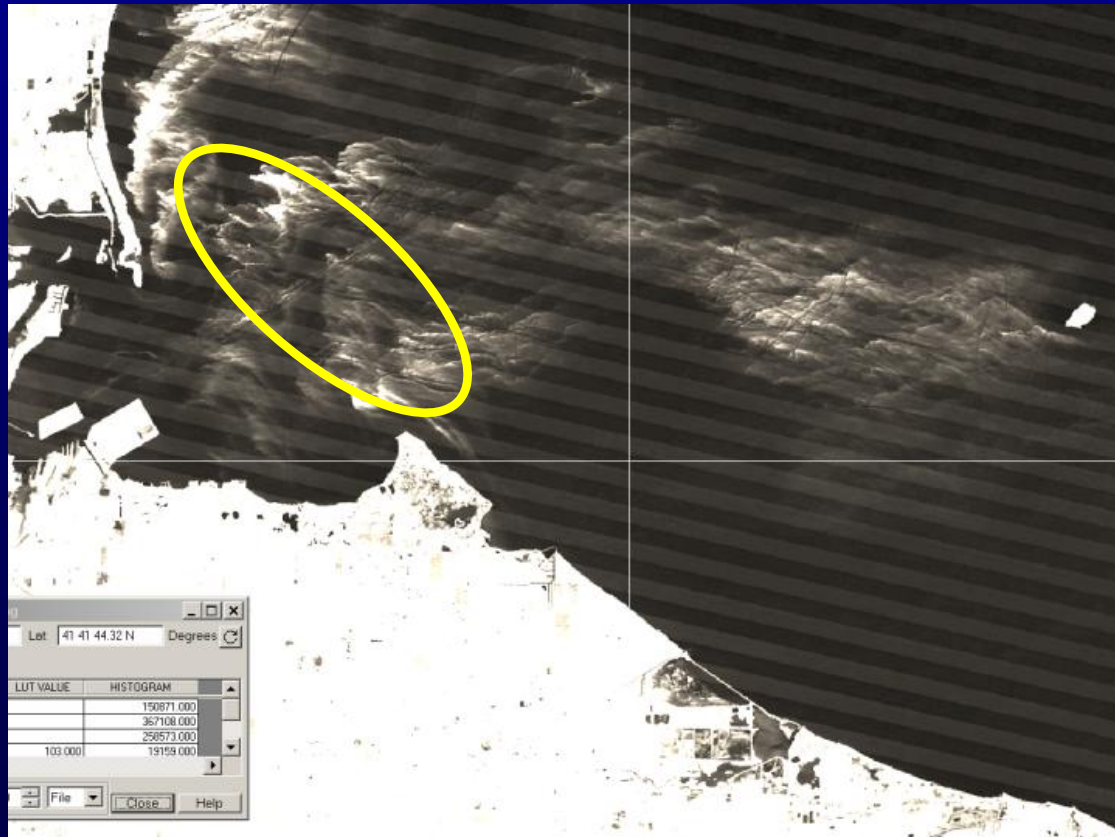
Questions

1. What determines the occurrence and size of blooms?

2. What is the influence of the Maumee River on blooms?

Observations

Blooms initiate in the same region each year



Questions

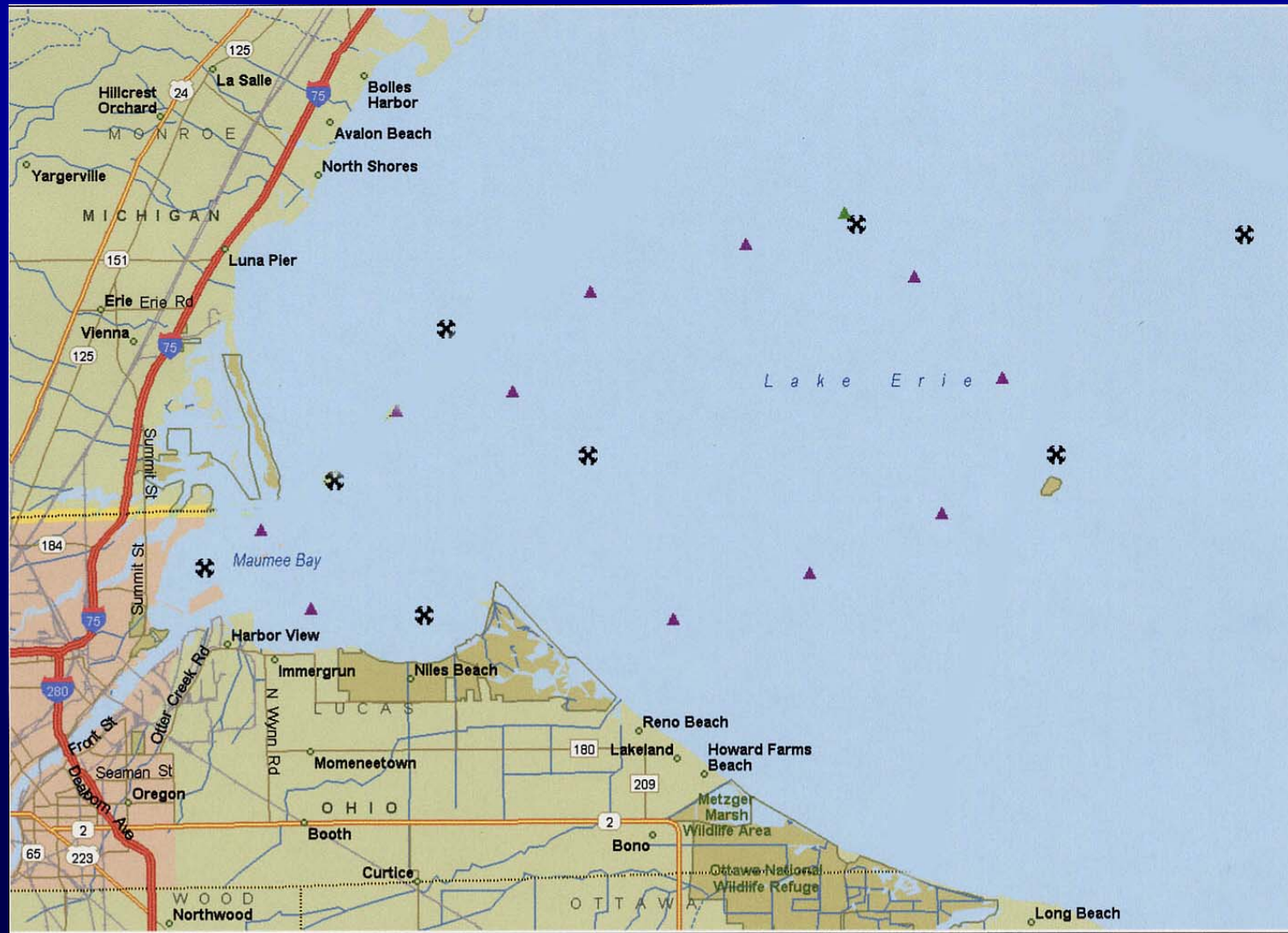
1. What determines the occurrence and size of blooms?
2. What is the influence of the Maumee River on blooms?
3. What triggers blooms to form just outside of Maumee Bay?

Questions

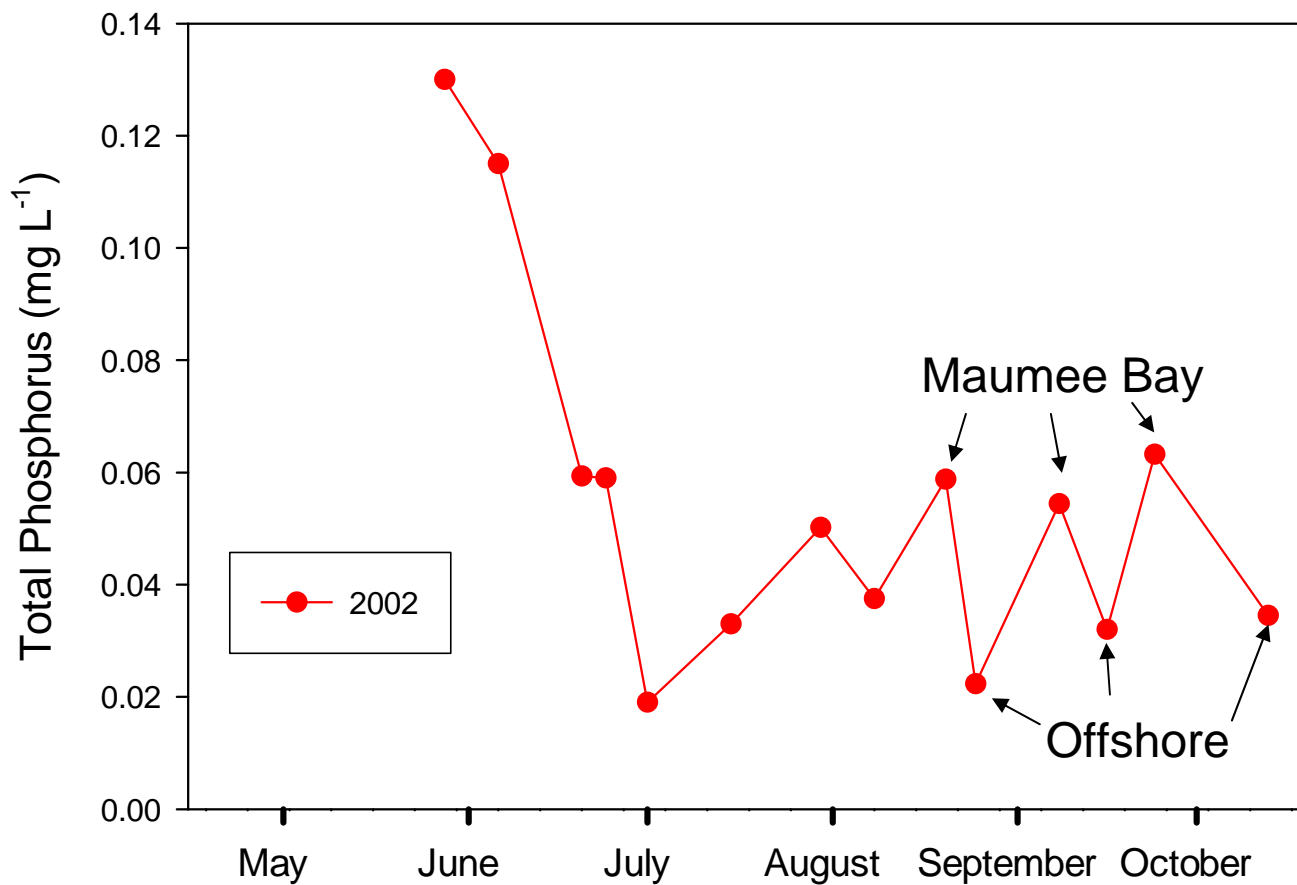
1. What determines the occurrence and size of blooms?

Examine Total Phosphorus 2002-2006

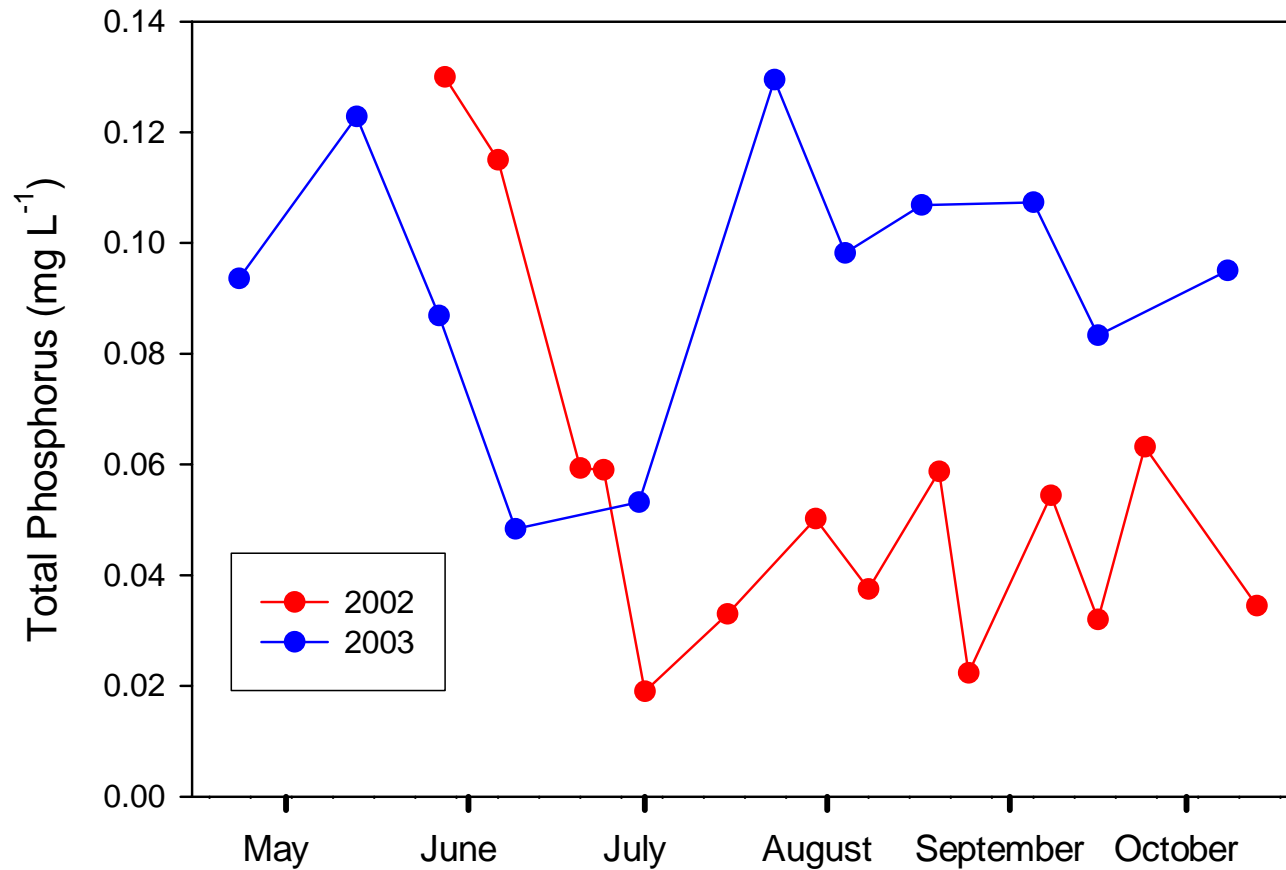
Western Lake Erie sampling locations



Total Phosphorus: 2002

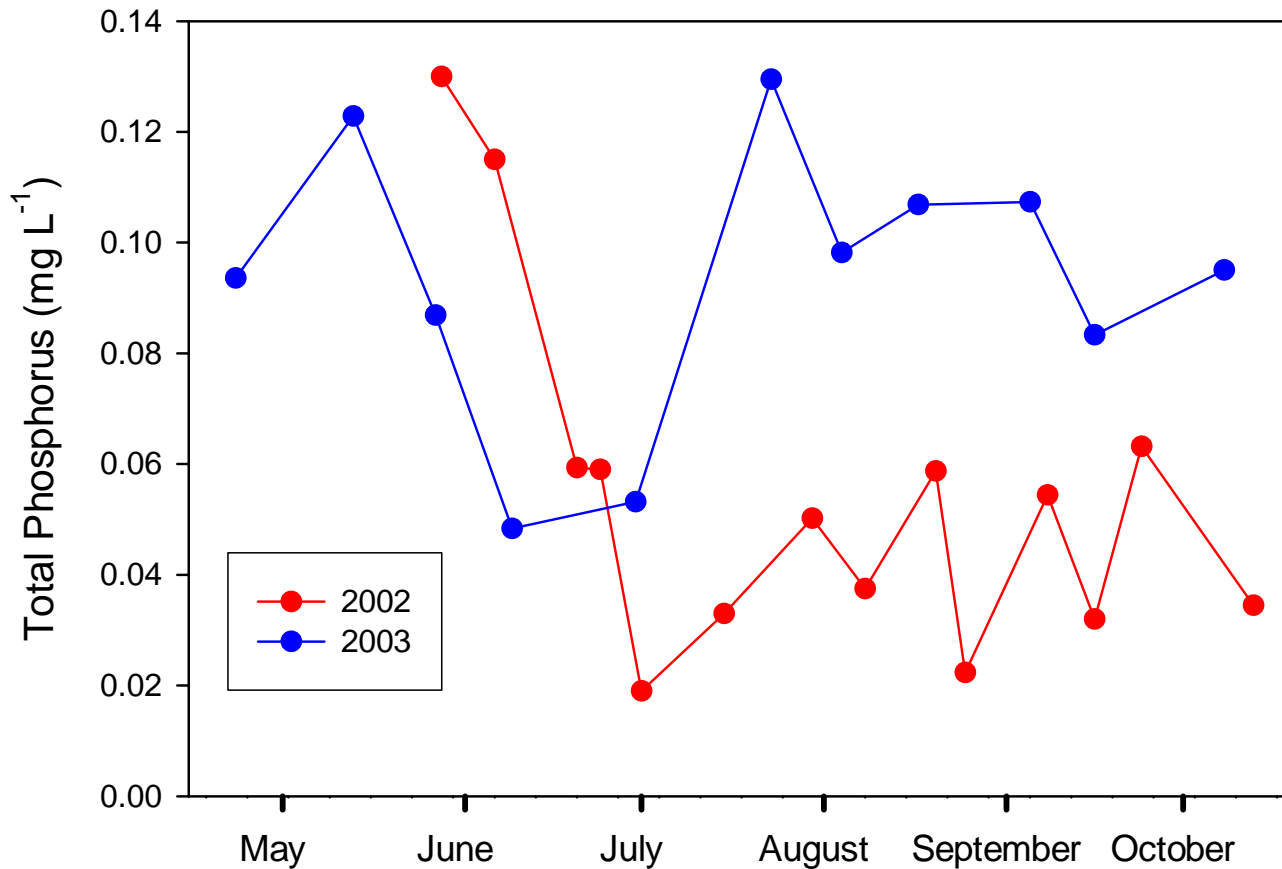


Total Phosphorus: 2002-03



Risk of cyanobacteria dominance

(Downing, et al. 2001)

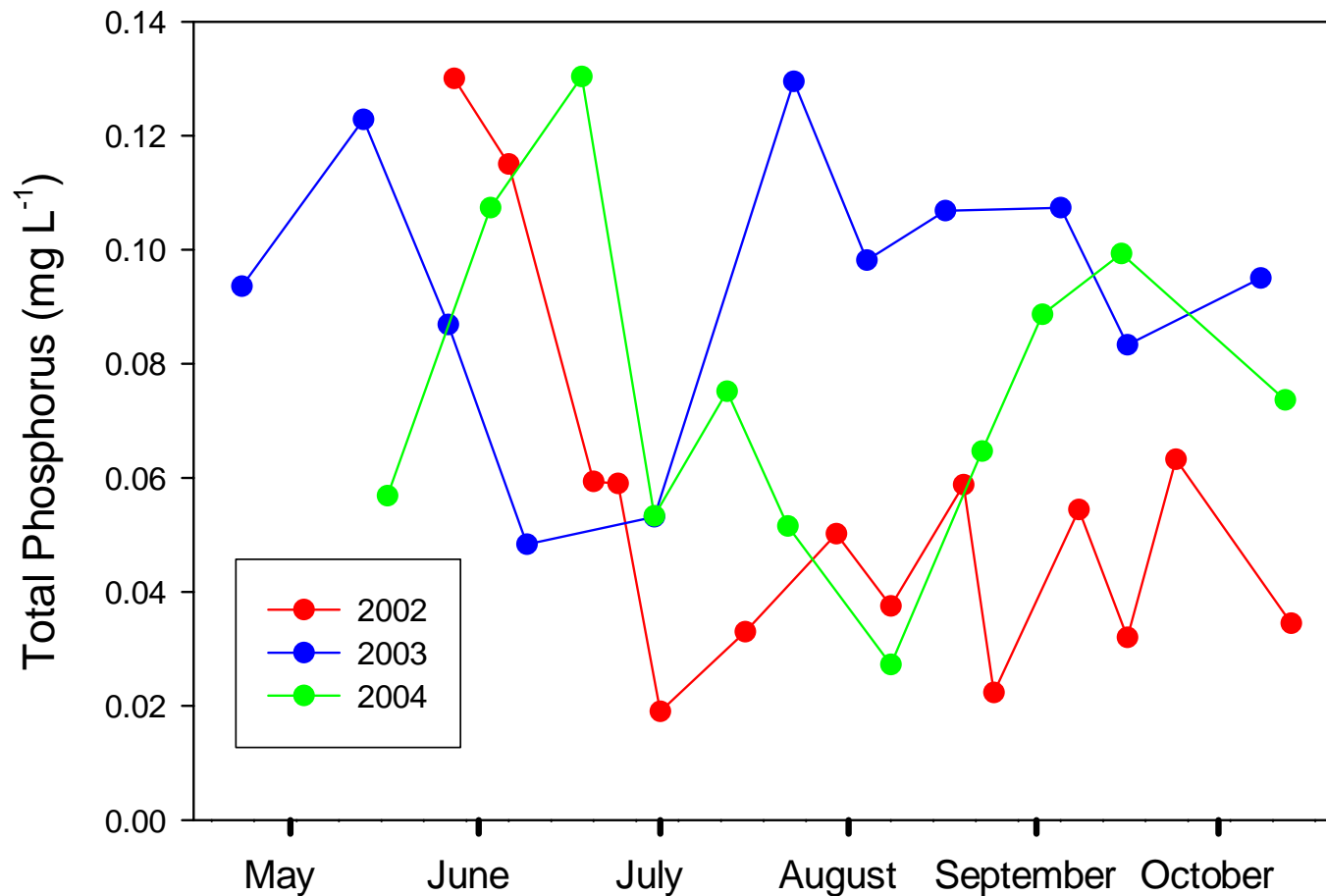


100%

40%

10%

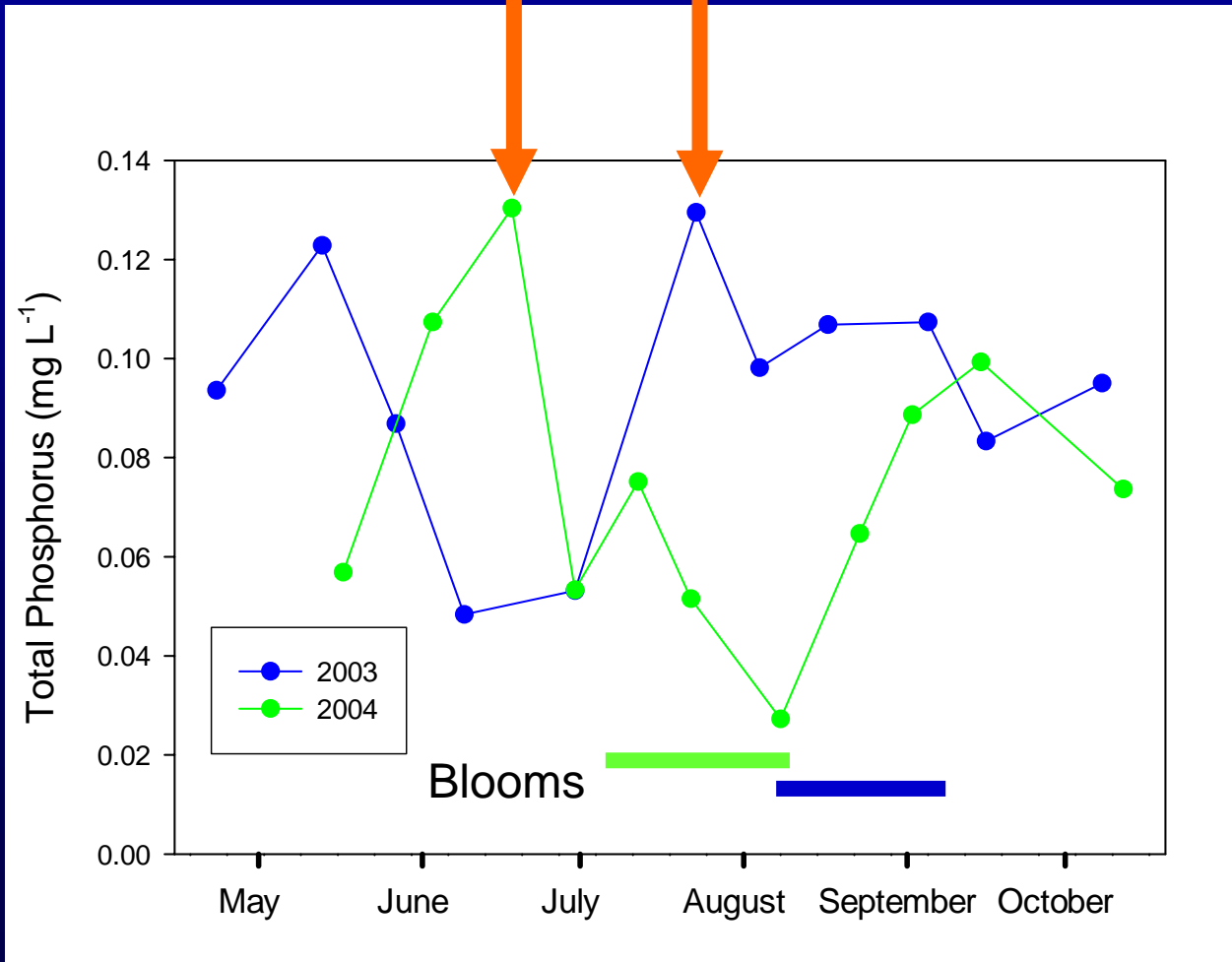
Total Phosphorus: 2002-04



Timing of phosphorus may be important

2004: TP maximum in June

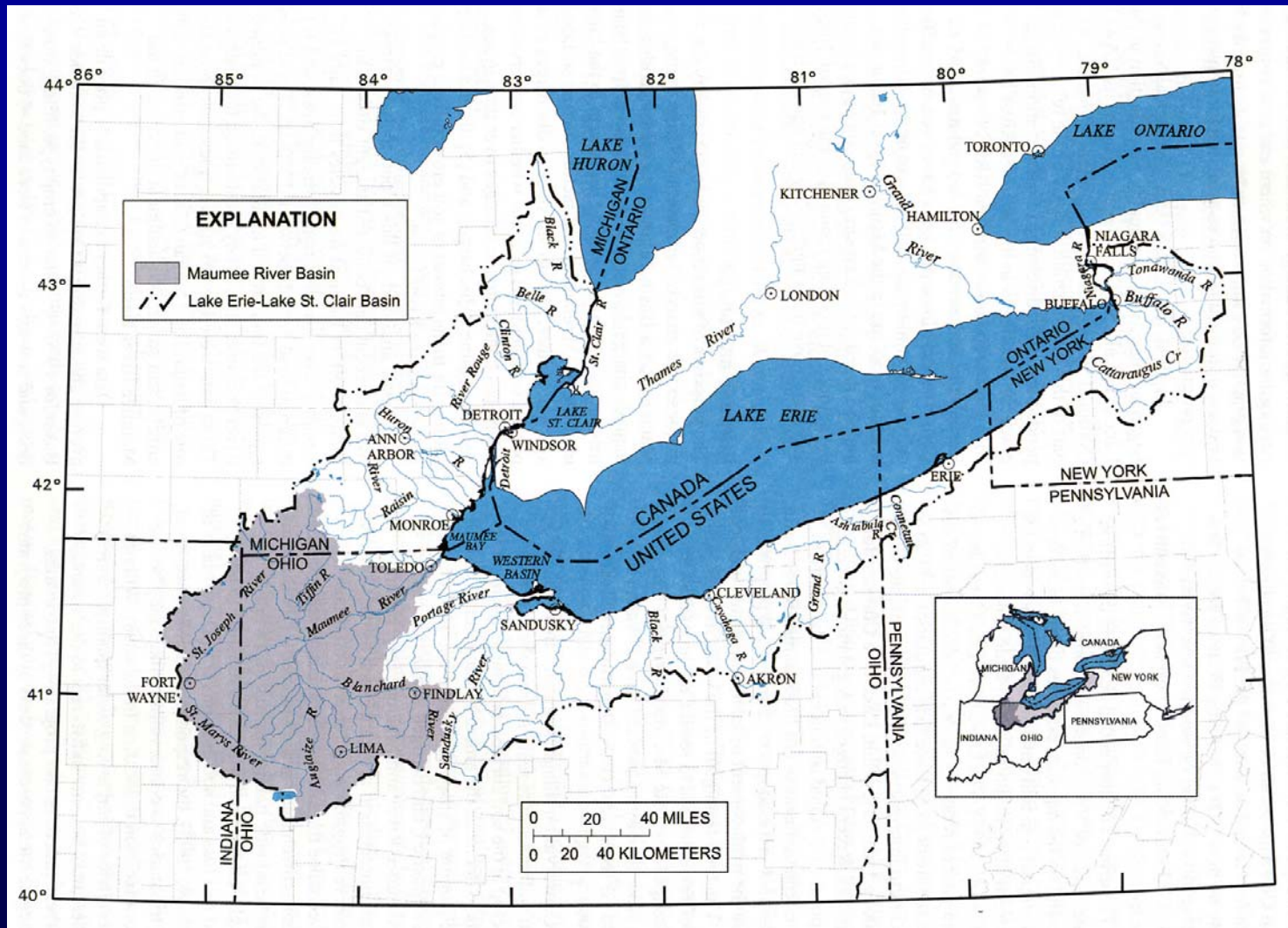
2003: TP maximum in July



Questions

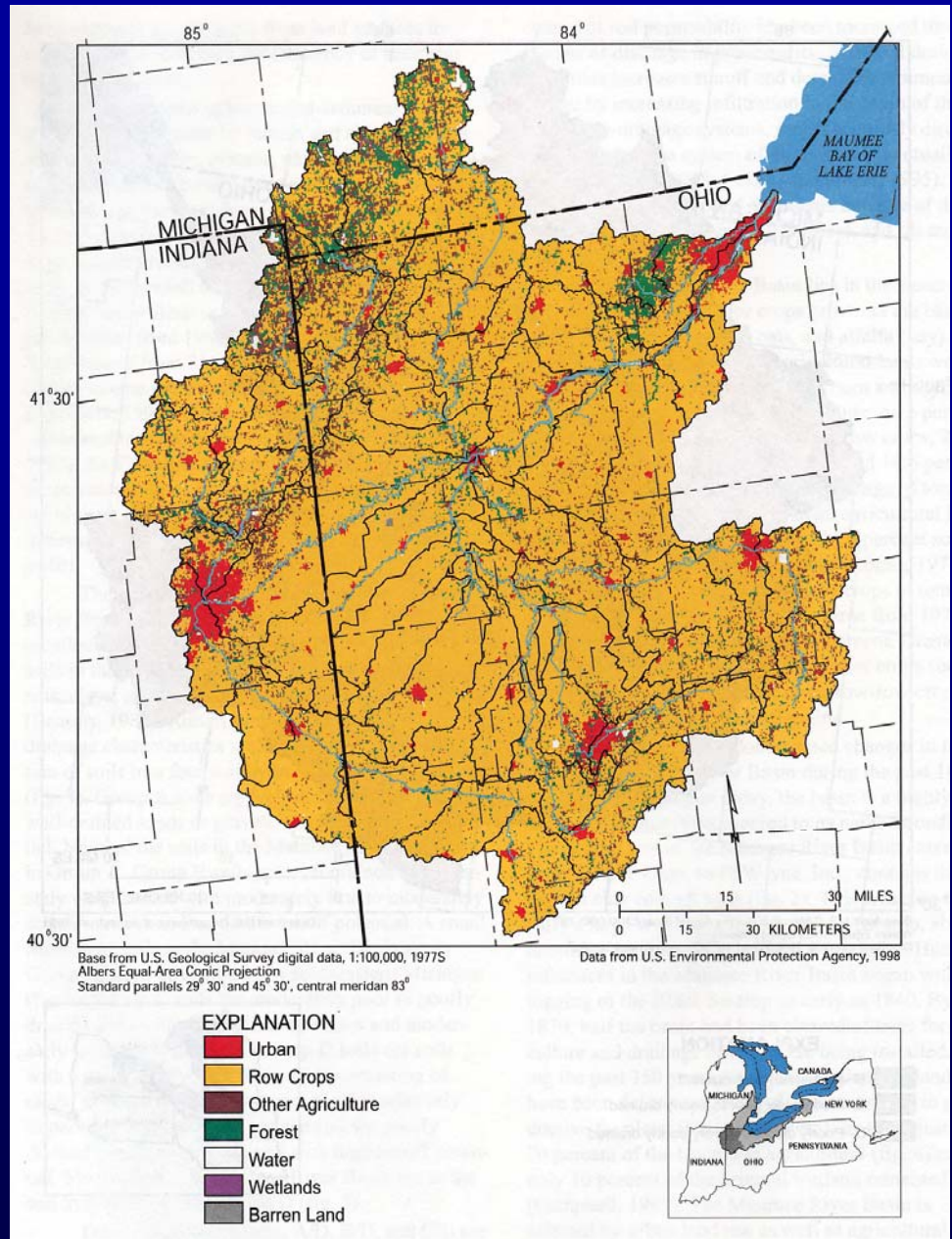
2. What is the influence of the Maumee River on blooms?

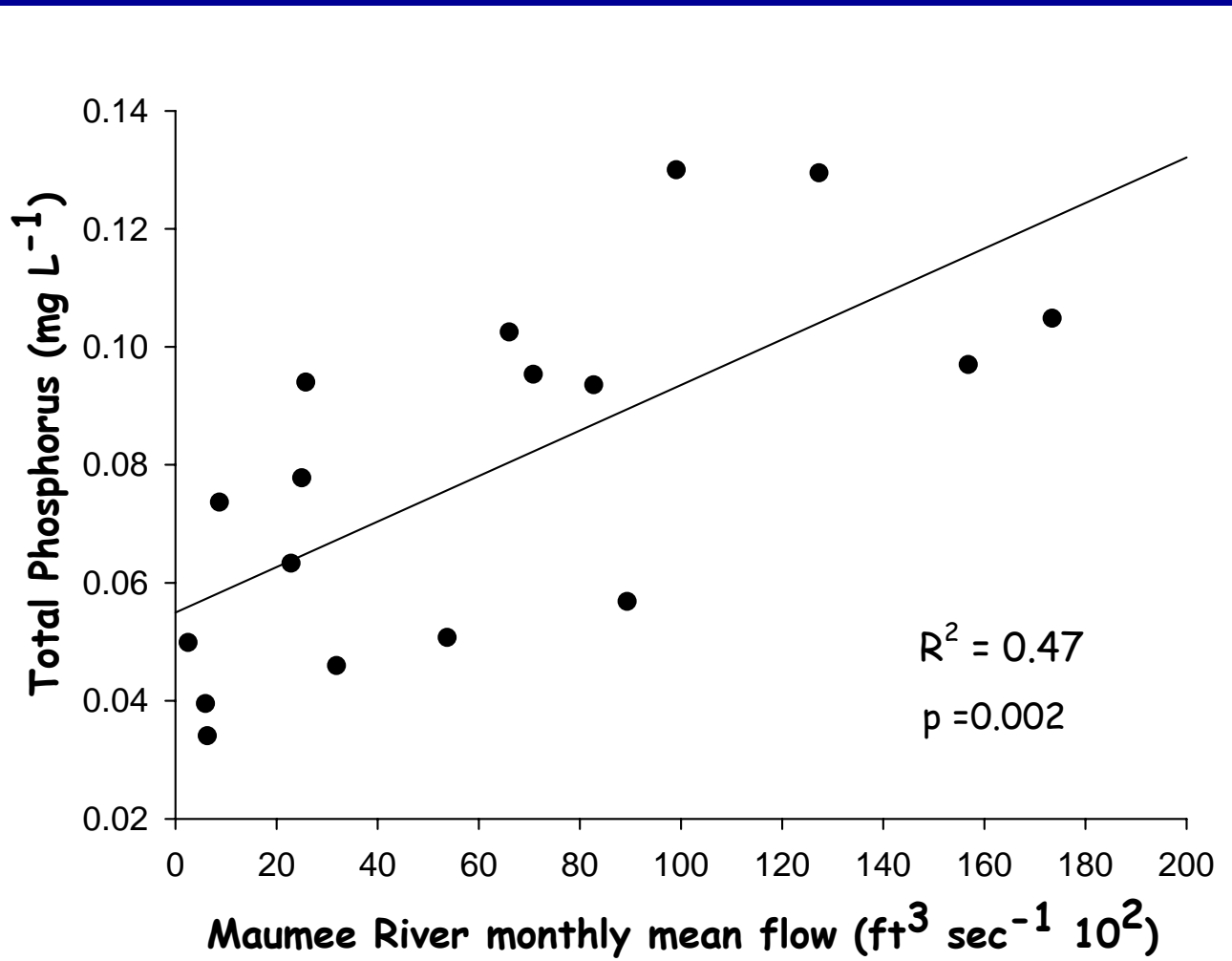
Maumee River Watershed



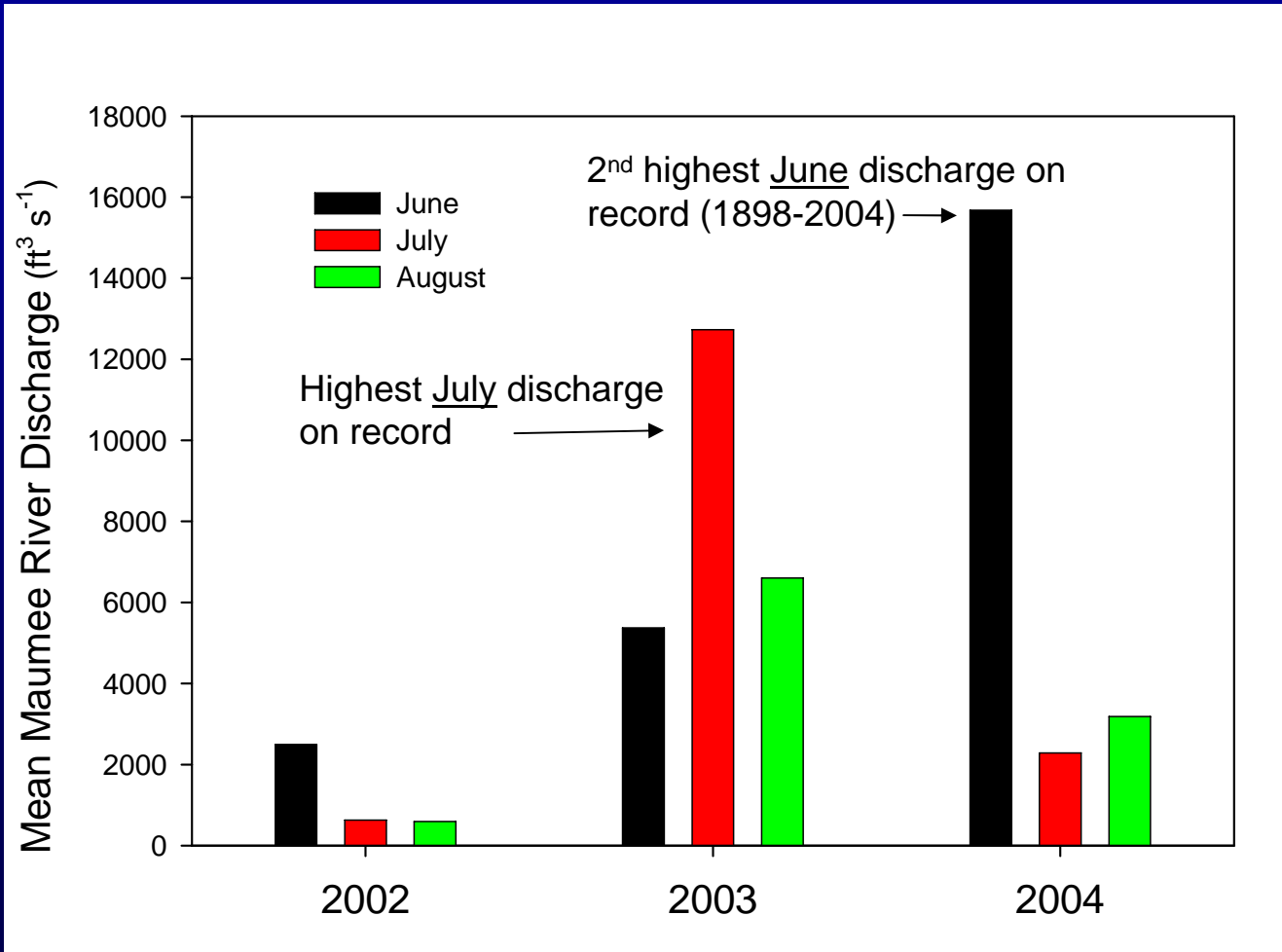
Maumee River Watershed

Land Use



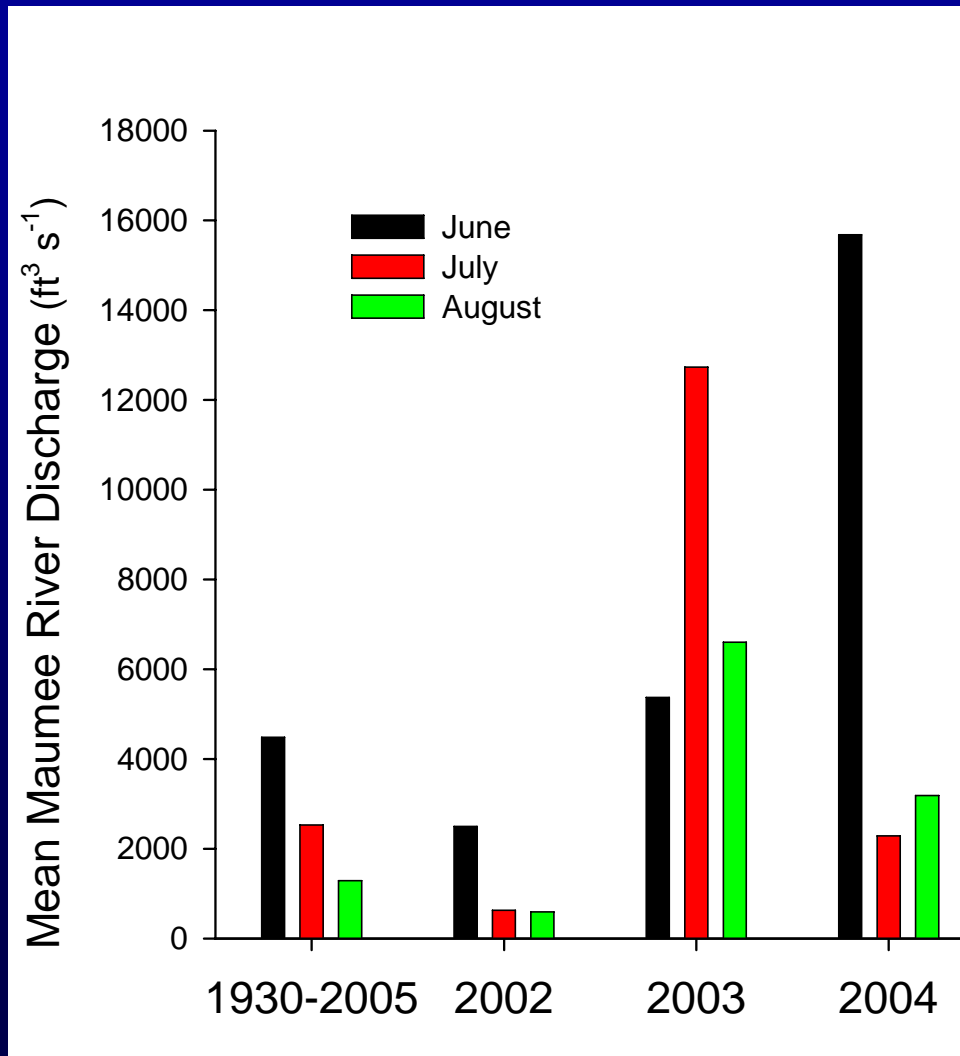


Maumee River summer discharge

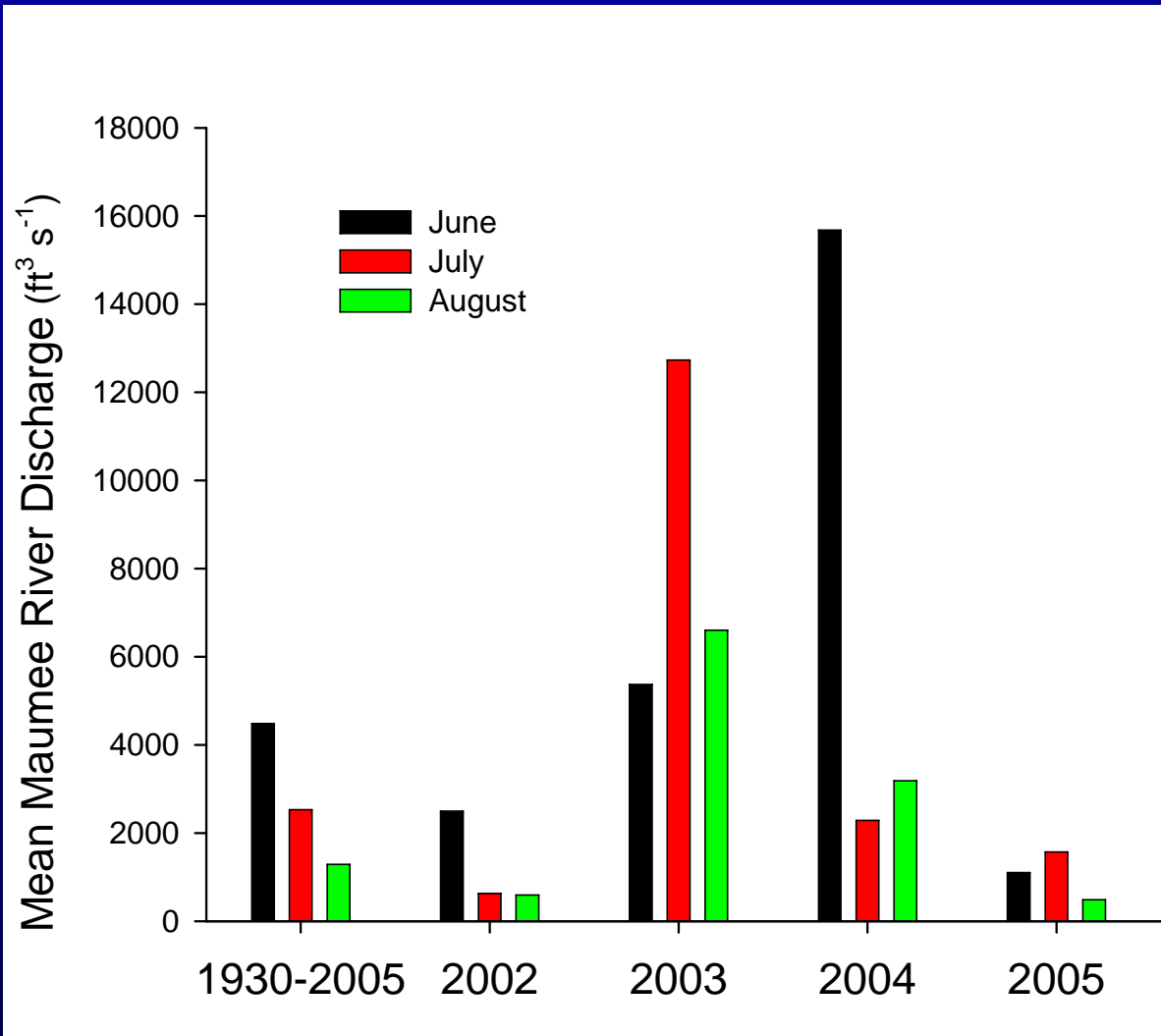


(Source data: USGS)

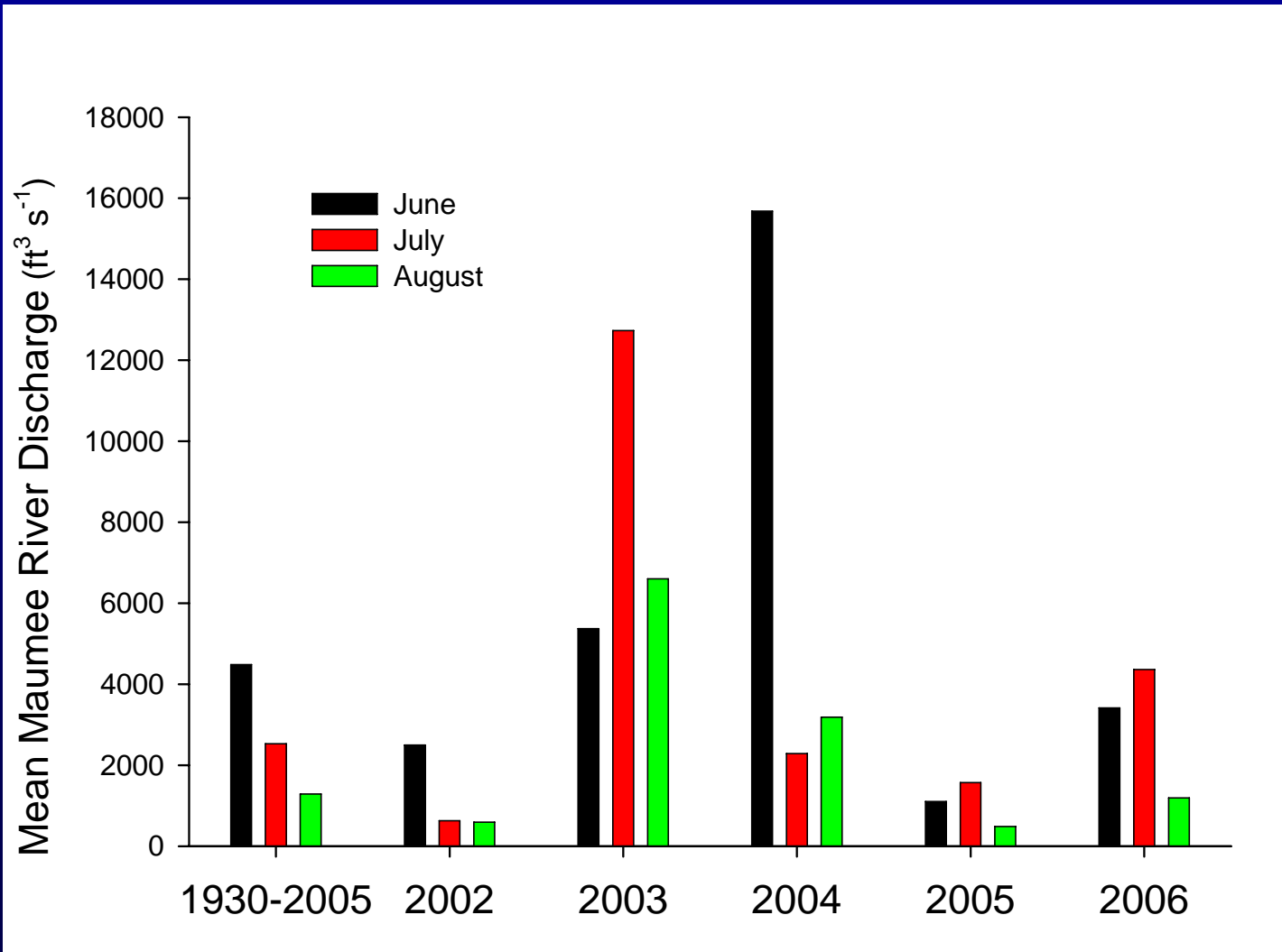
Maumee River summer discharge

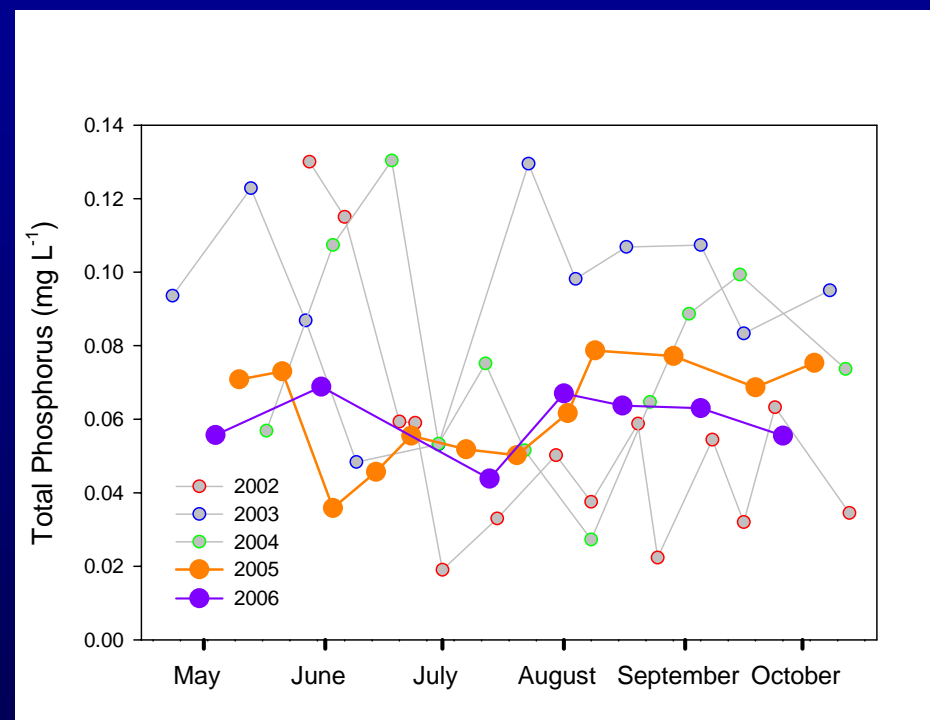
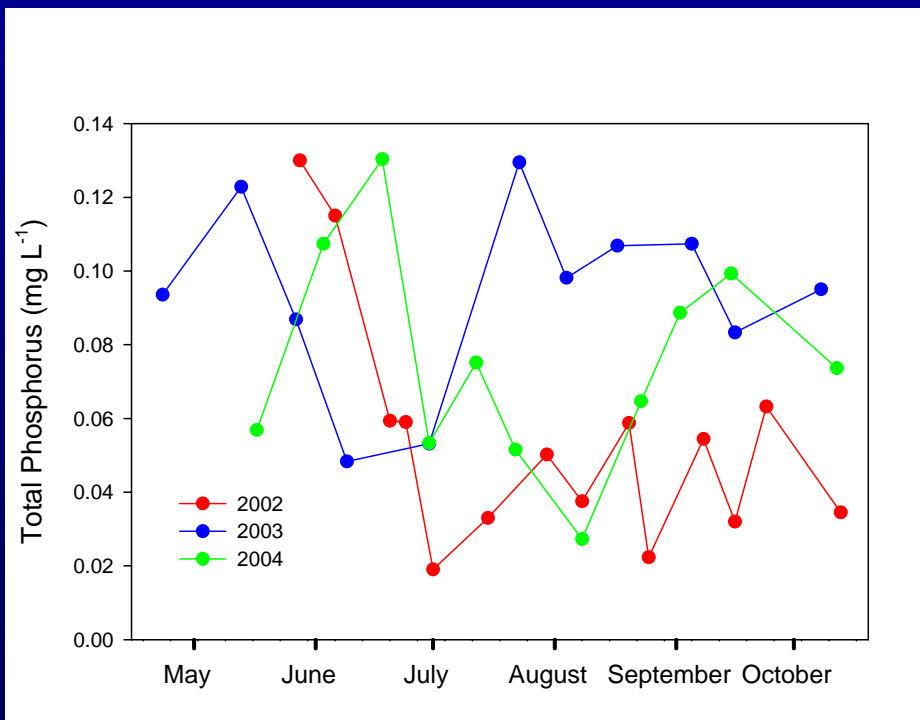


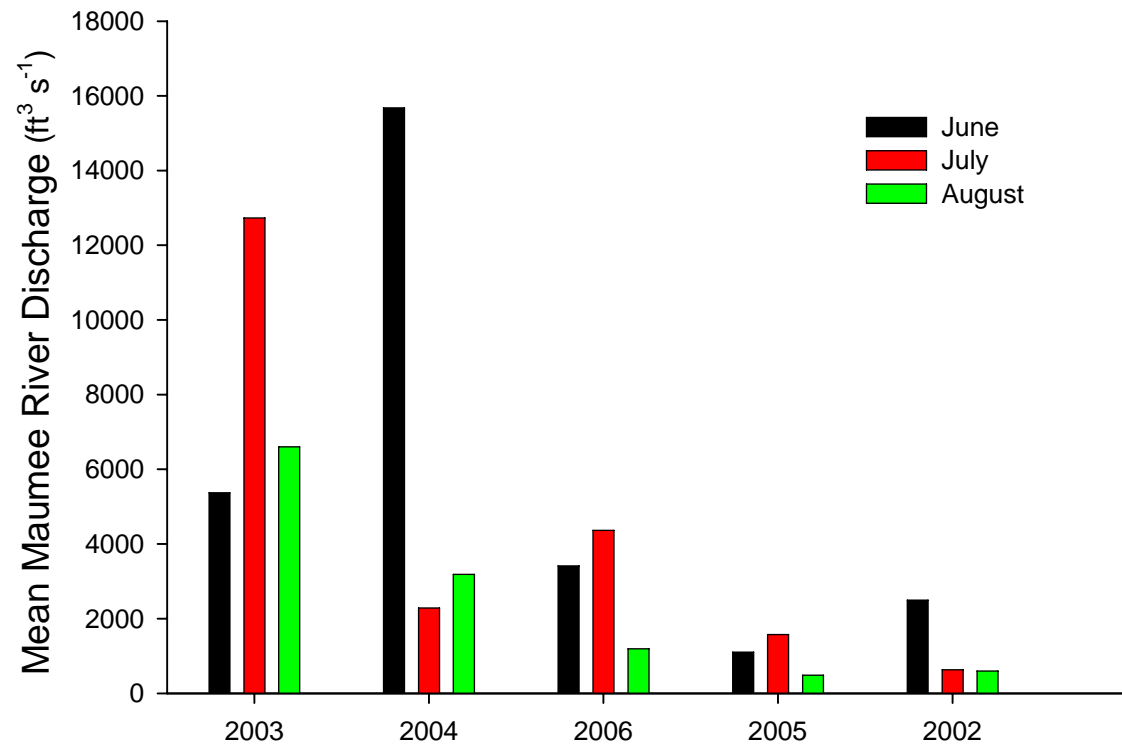
Maumee River summer discharge



Maumee River summer discharge







Bloom Biomass Rank

1

2

3

4

5

Observations (Part 1)

1. *Microcystis* blooms form in years with high TP concentrations.
2. High TP concentrations are associated with high Maumee River flow.
3. Seasonal timing of blooms may be associated with timing of river flow (July vs. August).

Questions

1. What determines the occurrence and size of blooms?

2. What is the influence of the Maumee River on blooms?

3. What triggers blooms to form just outside of Maumee Bay?

Or

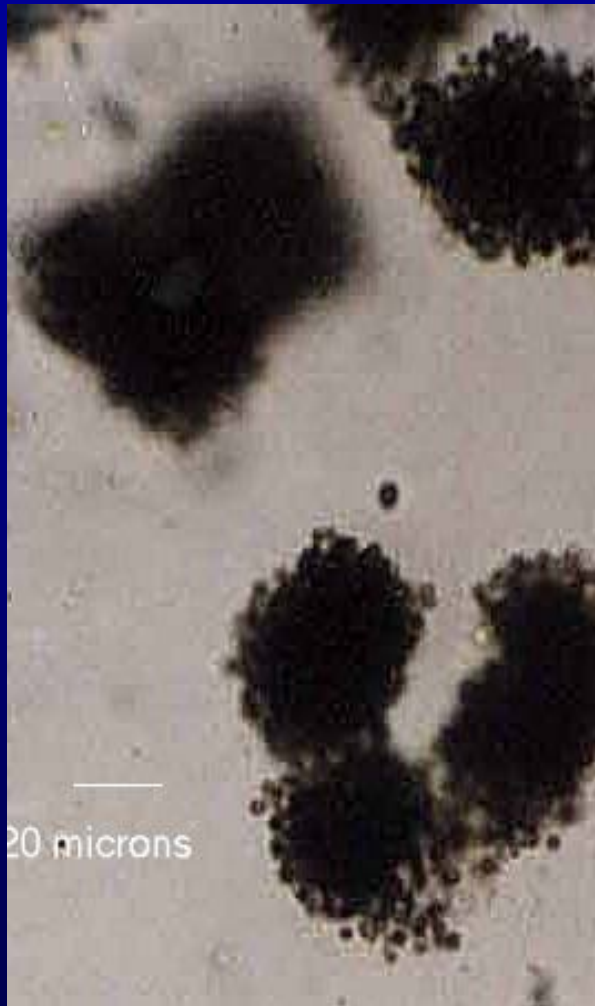
What is it about this location that allows *Microcystis* to out-compete other algae?



Aphanizomenon prevails
under conditions of:

Nitrogen-limitation

no mixing

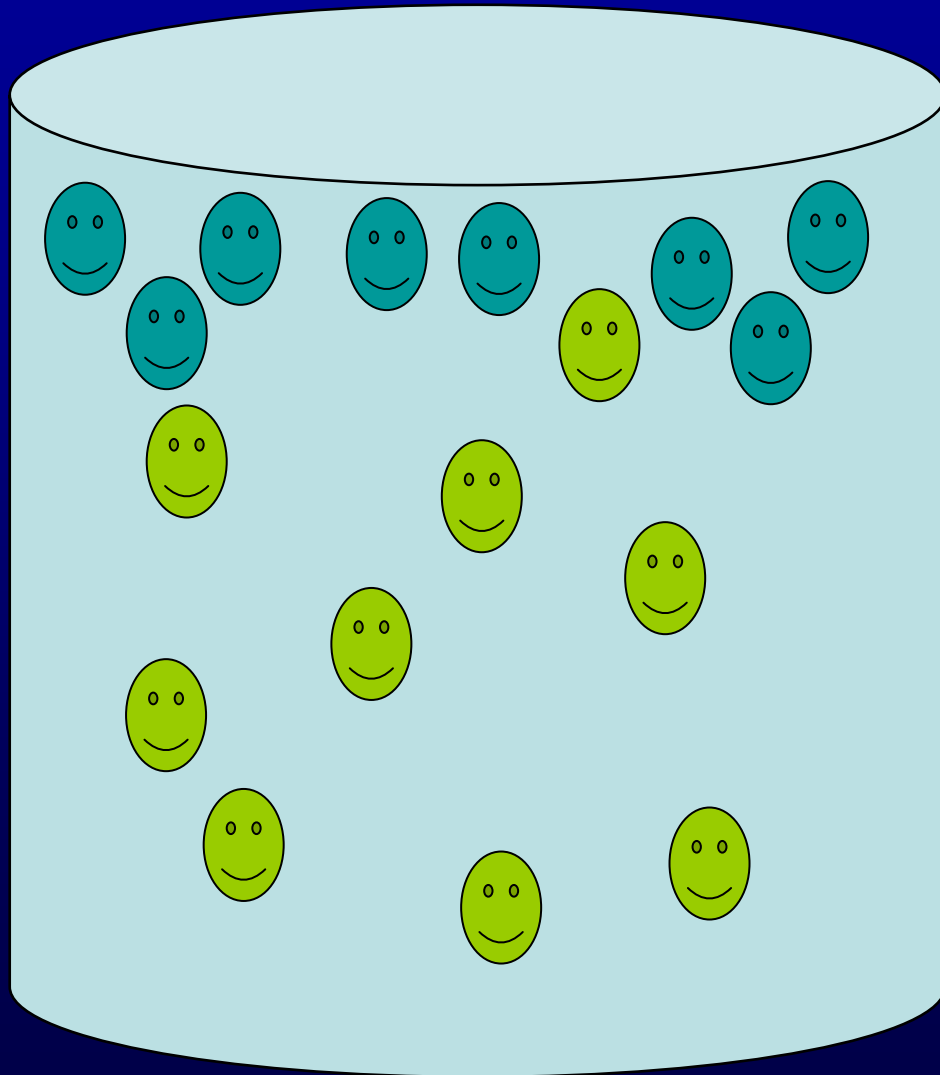


Microcystis prevails under conditions of:

No nitrogen-limitation

Moderate mixing

Microcystis has superior buoyancy



 = *Microcystis*

 = Aphanizomenon
and green algae

Microcystis has superior buoyancy



Mixed plankton

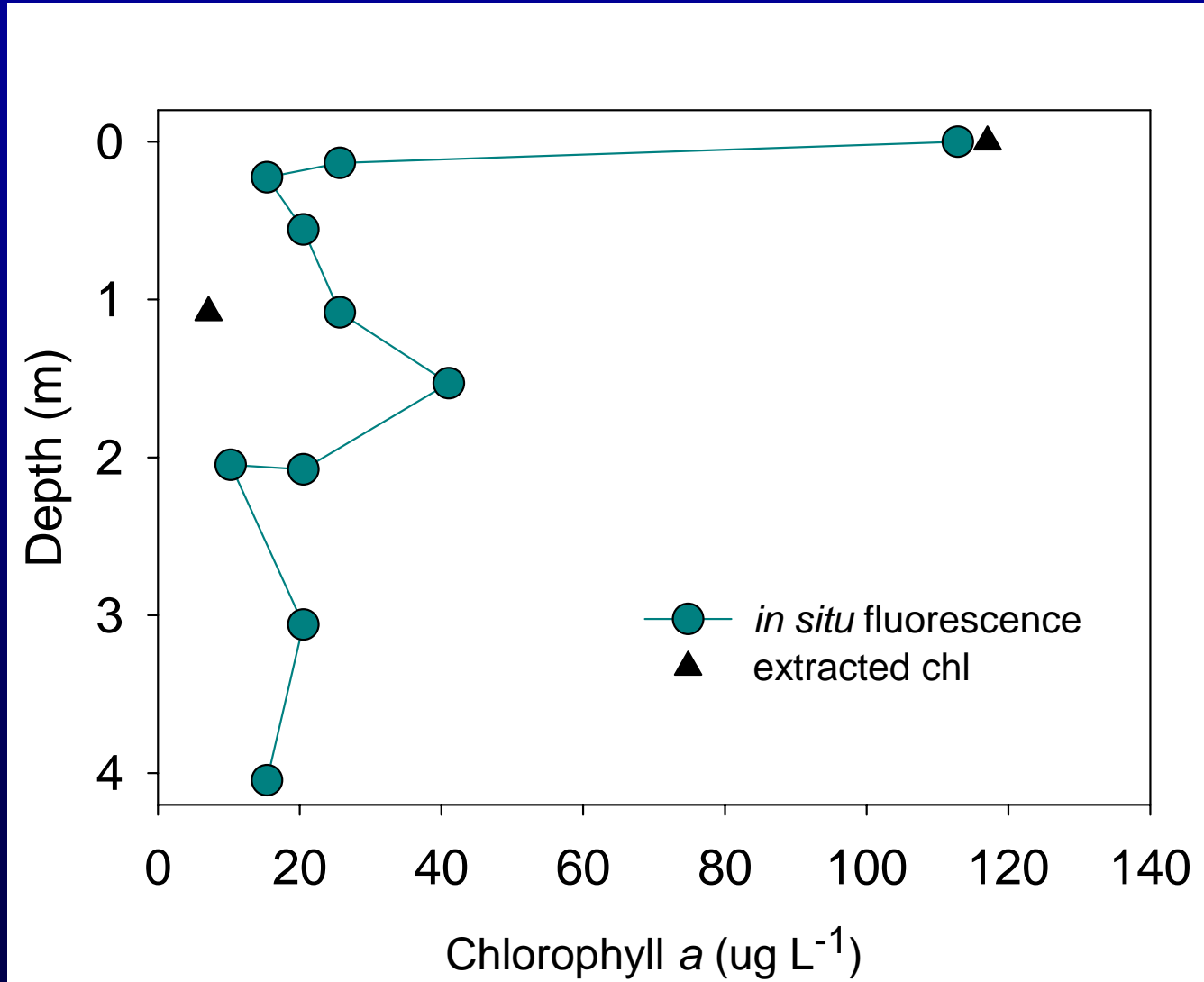


After 1 Hour



After 1 Day

Chlorophyll depth profile

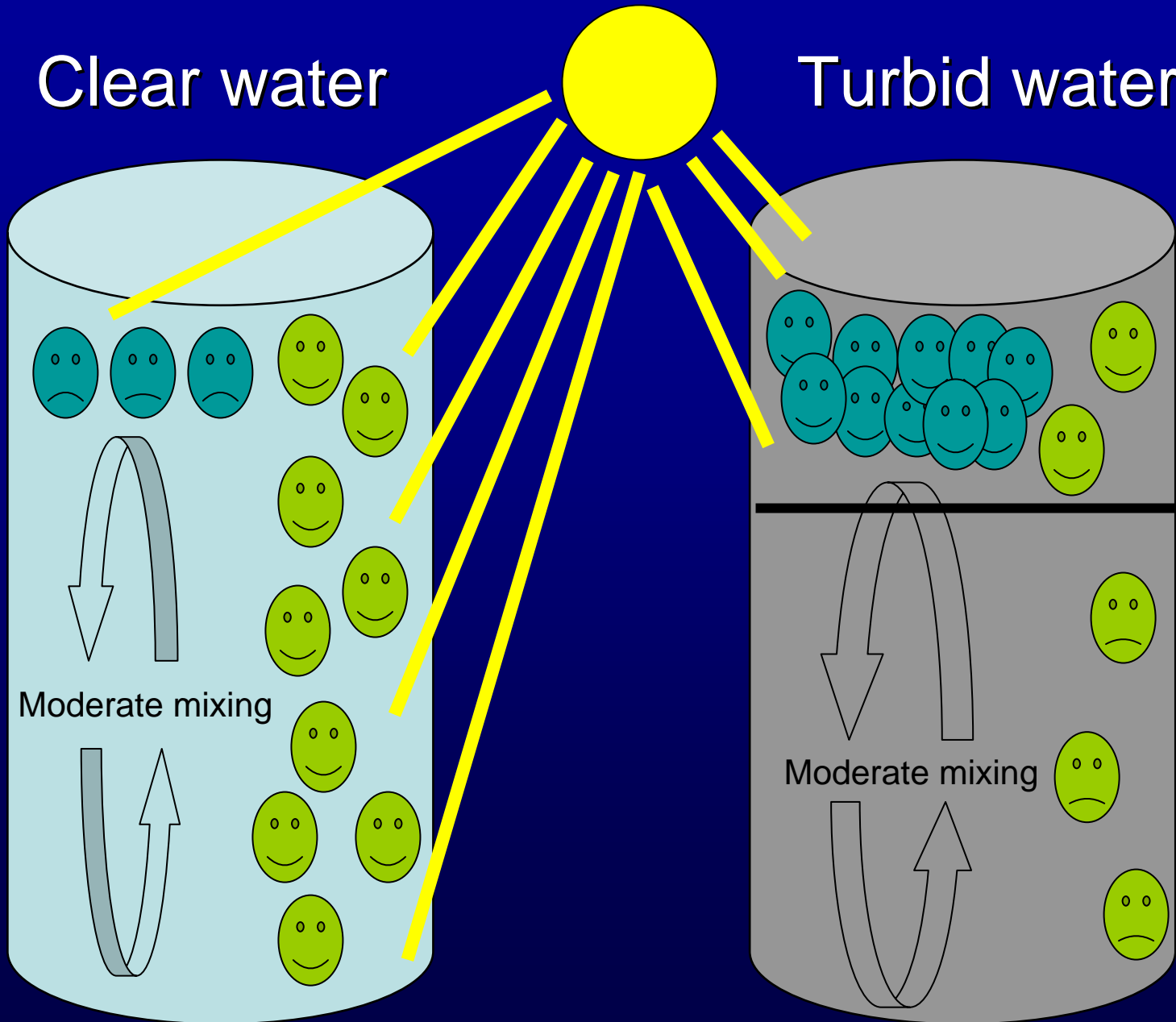


Hypothesis: High turbidity (suspended sediments) in the Maumee River plume gives *Microcystis* an advantage over other green and blue-green algae

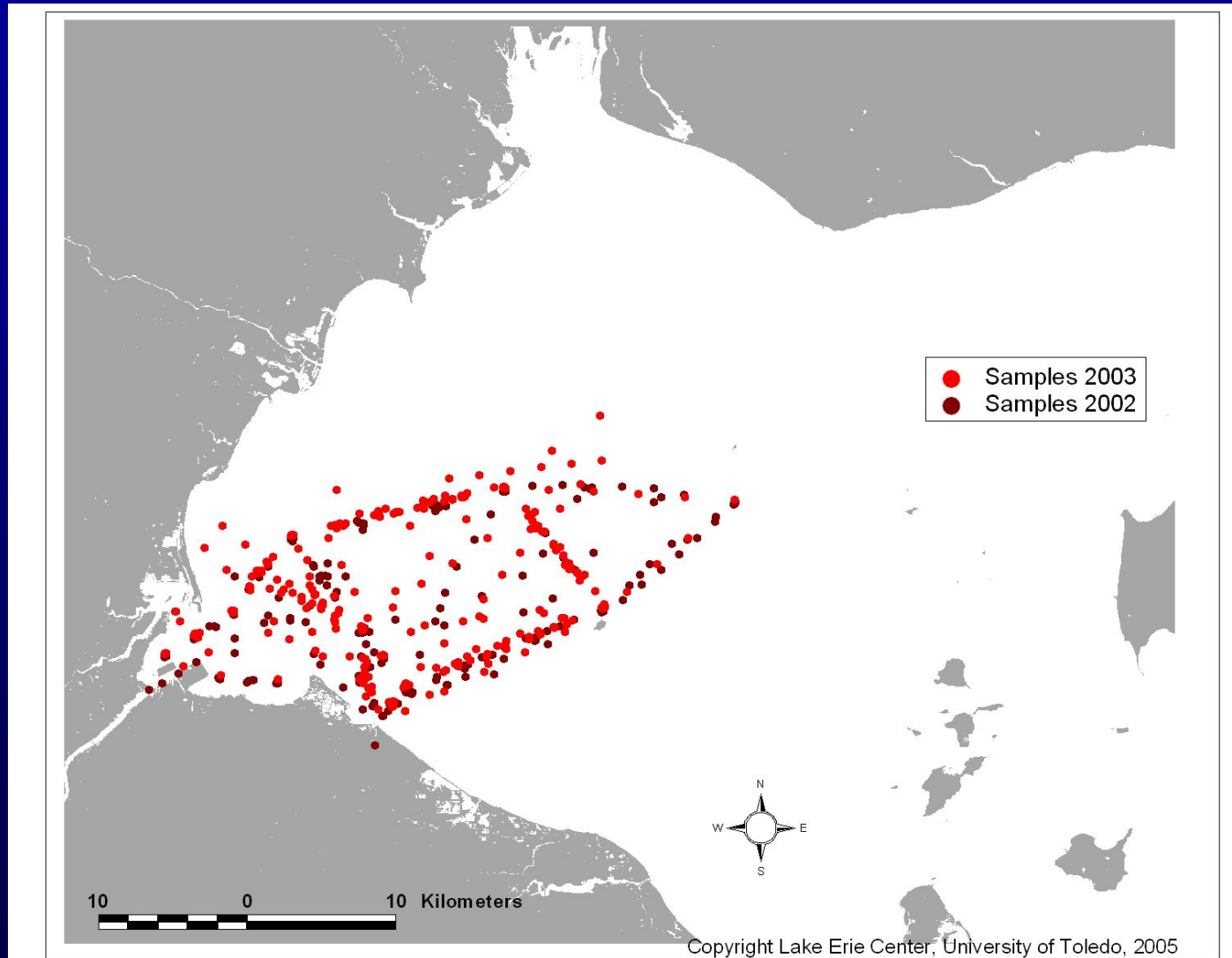


Clear water

Turbid water



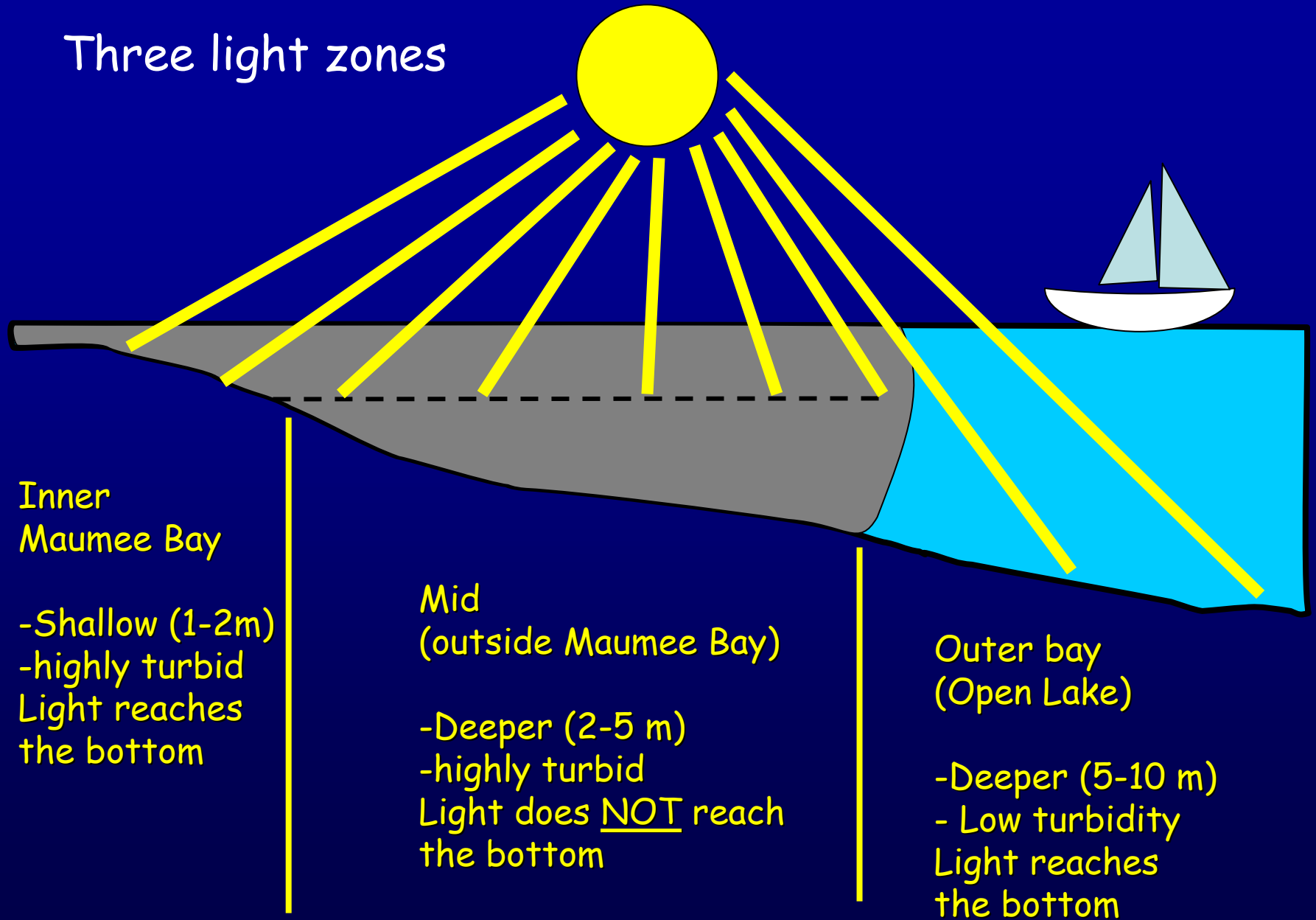
Light measurements (2002-04)



Maumee Bay light zones



Three light zones



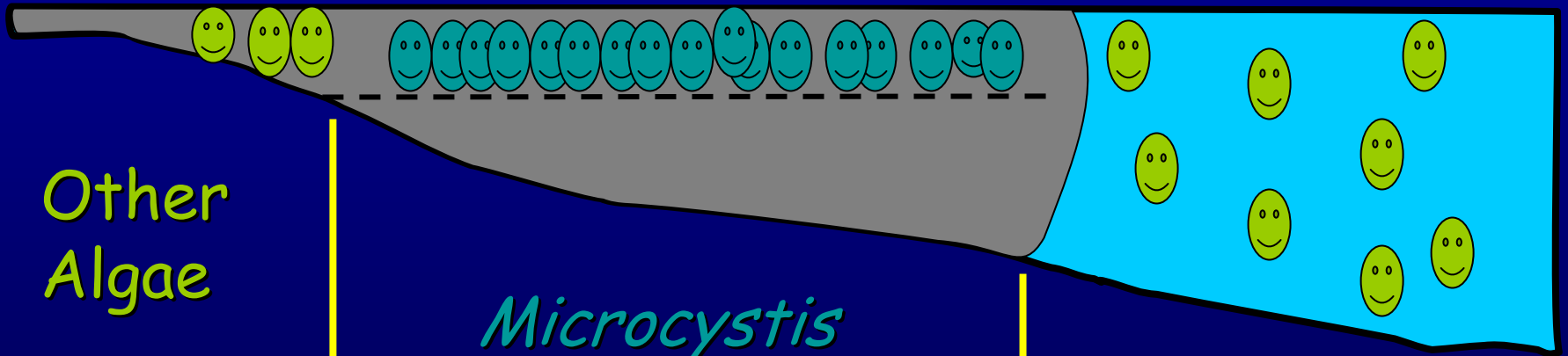
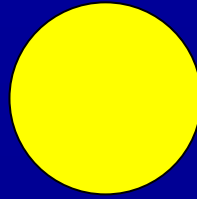
Maumee Bay light zones



Average Depth of Light Penetration (1%) July-Aug, 2002-04



n Kpar = 99
n Secchi = 292



Other
Algae

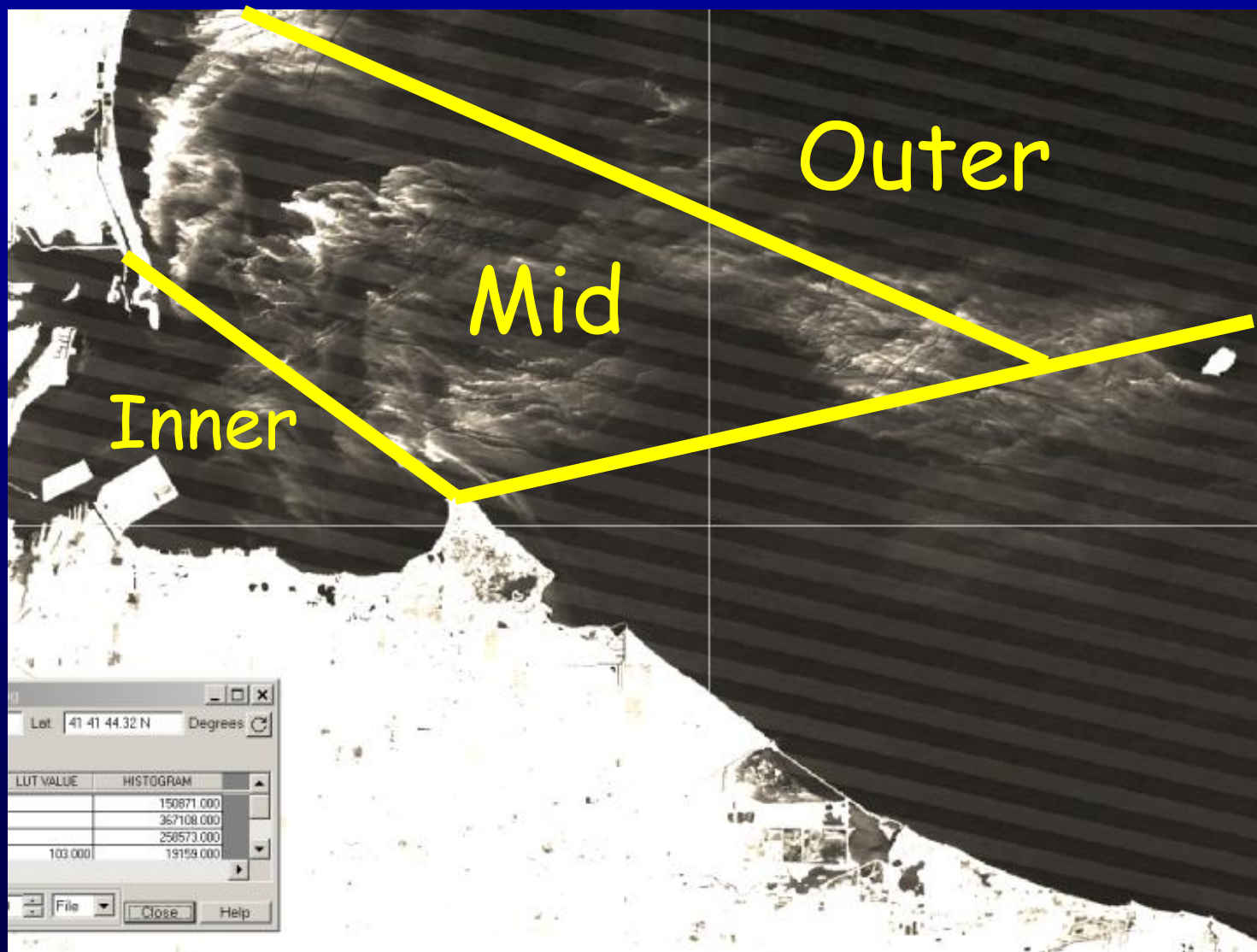
Microcystis

Other Algae

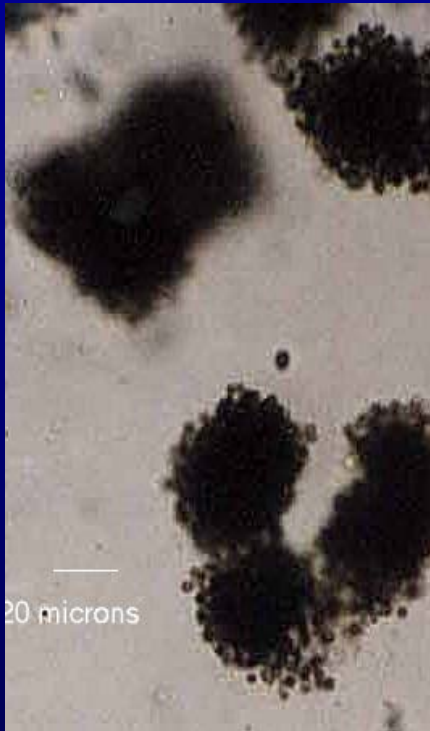
Inner

Mid

Outer



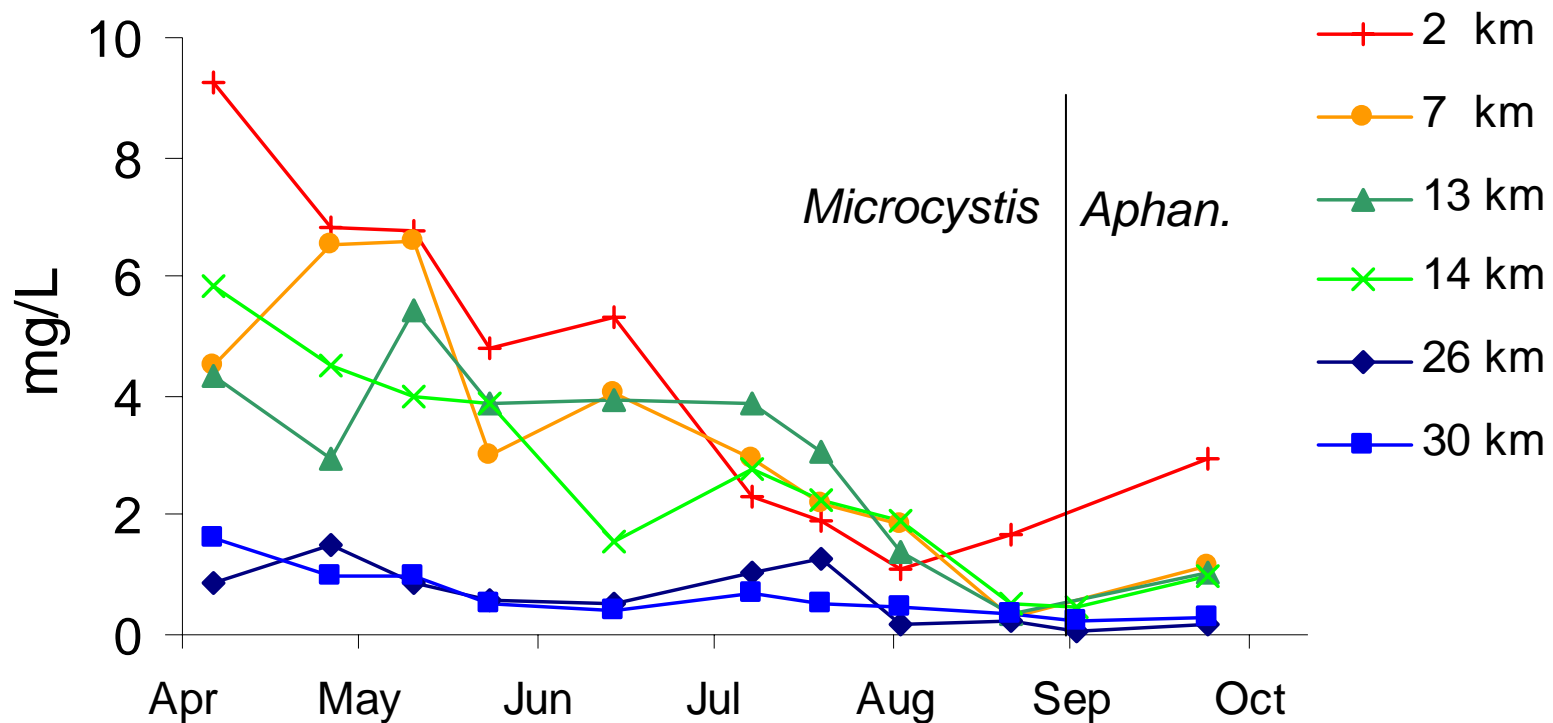
Post-Bloom Transition



Microcystis

Aphanizomenon

Nitrate (2003)



Observations (Part 2)

1. Maumee Bay has distinct light climates based on turbidity and depth.
2. In 2002-2006, *Microcystis* first appeared in areas with greatest potential for light-limitation.
3. Seasonal decline in available nitrogen leads to a transition from *Microcystis* to *Aphanizomenon*.

September 2006

Mystery Bloom



Acknowledgements



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